STP7N65M2, STU7N65M2

N-channel 650 V, 0.98 Ω typ., 5 A MDmesh™ M2 Power MOSFETs in TO-220 and IPAK packages

Datasheet - production data

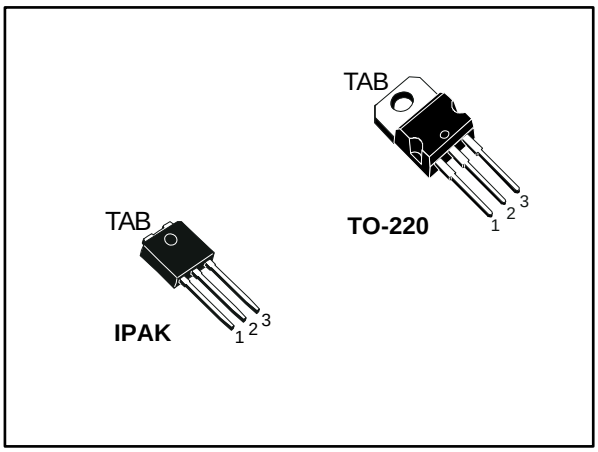
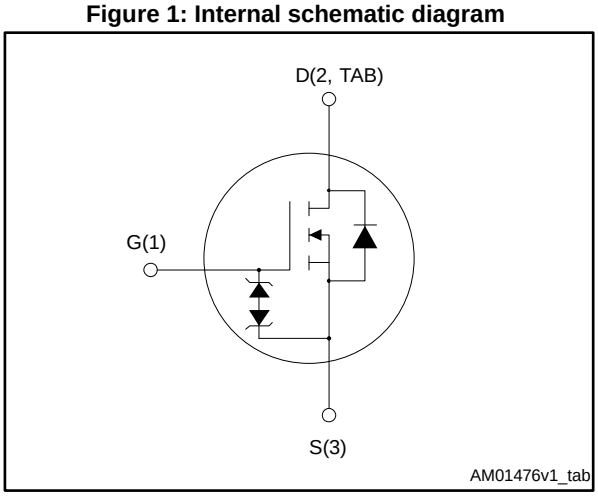


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max	I_D
STP7N65M2	650 V	1.15 Ω	5 A
STU7N65M2	650 V	1.15 Ω	5 A

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the MDmesh™ M2 technology. Thanks to the strip layout associated with an improved vertical structure, the device exhibits both low on-resistance and optimized switching characteristics. It is therefore suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STP7N65M2	7N65M2	TO-220	Tube
STU7N65M2	7N65M2	IPAK	Tube

This is information on a product in full production.

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	5	A
I_D	Drain current (continuous) at T_C = 100 °C	3.2	A
I_{DM} (1)	Drain current (pulsed)	20	A
P_{TOT}	Total dissipation at T_C = 25 °C	60	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Operating junction temperature		

Notes:

(1)Pulse width limited by safe operating area

(2)I_{SD} ≤ 5 A, di/dt ≤ 400 A/µs; V_{DSpeak} < $V_{(BR)DSS}$, V_{DD}=400 V

(3)V_{DS} ≤ 520 V

Table 3: Thermal data

Symbol	Parameter	Value		Unit
		TO-220	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	2.08		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5	100	°C/W

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1	A
E_{AS}	Single pulse avalanche energy (starting T_j=25°C, I_D= I_{AR}; V_{DD}=50 V)	103	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 5: On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0, I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 650 V			1	µA
		V_{GS} = 0, V_{DS} = 650 V, T_C=125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 2.5 A		0.98	1.15	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	270	-	pF
C_{oss}	Output capacitance		-	14.5	-	
C_{rss}	Reverse transfer capacitance		-	0.8	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0	-	108	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 5 A, V_{GS} = 10 V (see *Figure 17: "Gate charge test circuit"*)	-	9	-	nC
Q_{gs}	Gate-source charge		-	2.3	-	nC
Q_{gd}	Gate-drain charge		-	4.3	-	nC

Notes:

(1)$C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 325 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 16: "Switching times test circuit for resistive load"* and *Figure 21: "Switching time waveform"*)	-	8	-	ns
t_r	Rise time		-	20	-	ns
$t_{d(off)}$	Turn-off delay time		-	30	-	ns
t_f	Fall time		-	20	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM} (1)	Source-drain current (pulsed)		-		20	A
V_{SD} (2)	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 21: "Switching time waveform"*)	-	275		ns
Q_{rr}	Reverse recovery charge		-	1.62		µC
I_{RRM}	Reverse recovery current		-	11.8		A
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 21: "Switching time waveform"*)	-	430		ns
Q_{rr}	Reverse recovery charge		-	2.54		µC
I_{RRM}	Reverse recovery current		-	11.9		A

Notes:

(1)Pulse width limited by safe operating area.

(2)Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area for TO-220

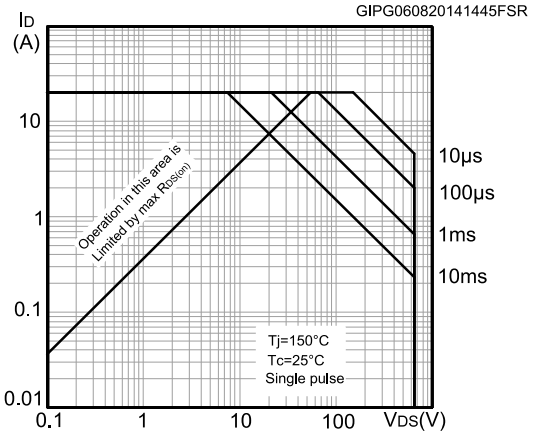


Figure 3: Thermal impedance for TO-220

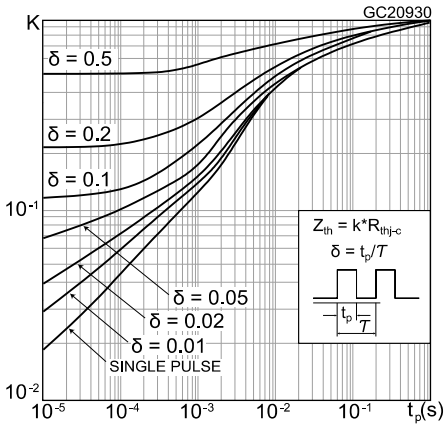


Figure 4: Safe operating area for IPAK

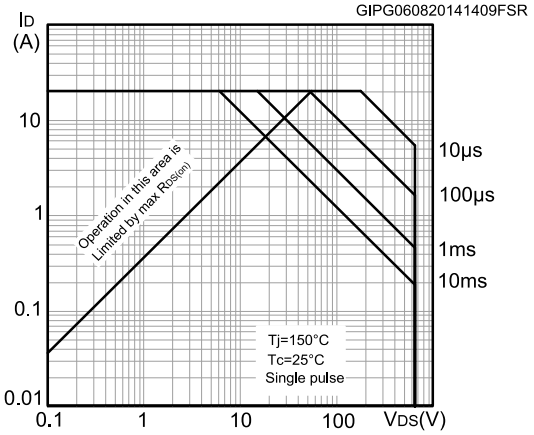


Figure 5: Thermal impedance for IPAK

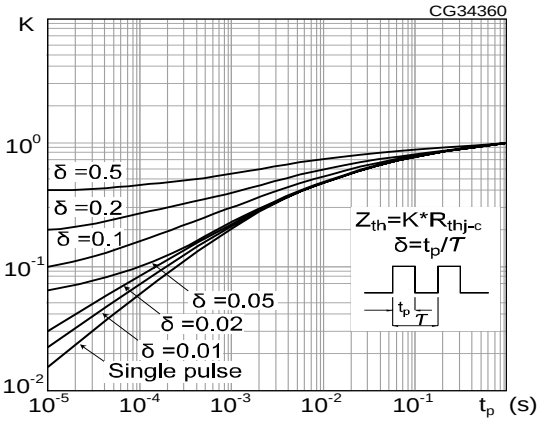


Figure 6: Output characteristics

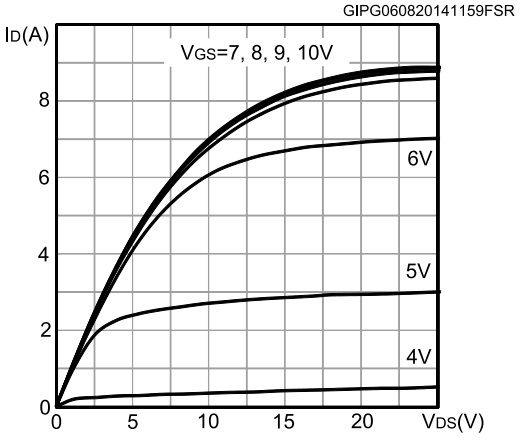


Figure 7: Transfer characteristics

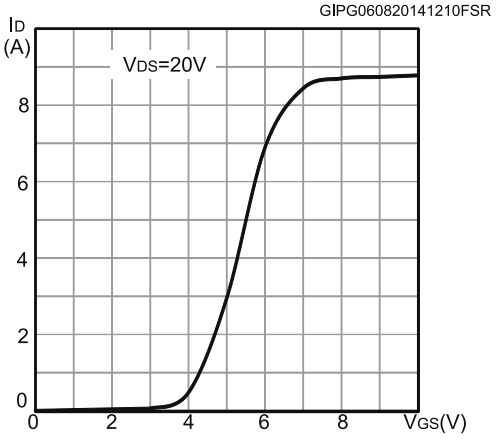


Figure 8: Gate charge vs gate-source voltage

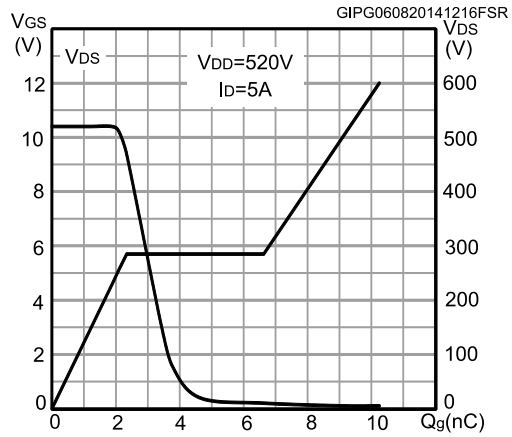


Figure 9: Static drain-source on-resistance

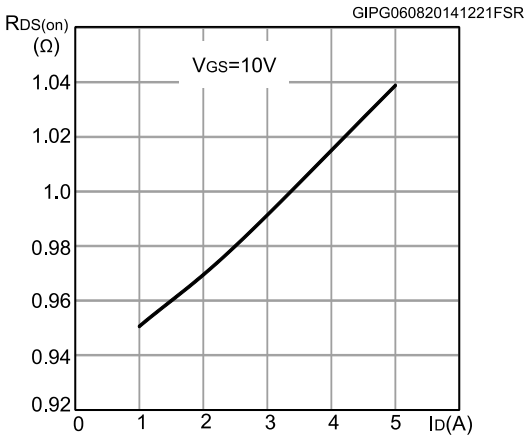


Figure 10: Capacitance variations

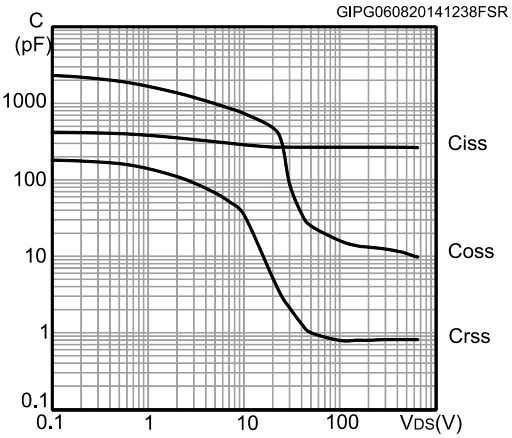


Figure 11: Output capacitance stored energy

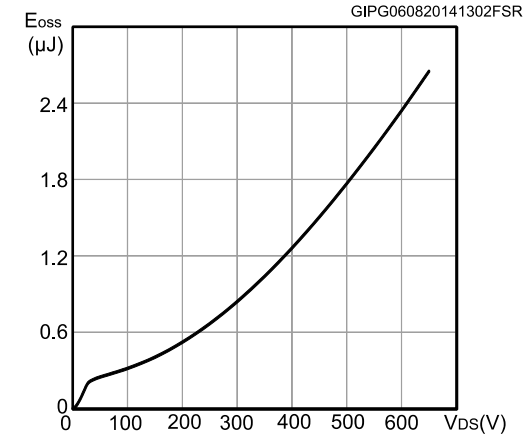


Figure 12: Normalized gate threshold voltage vs temperature

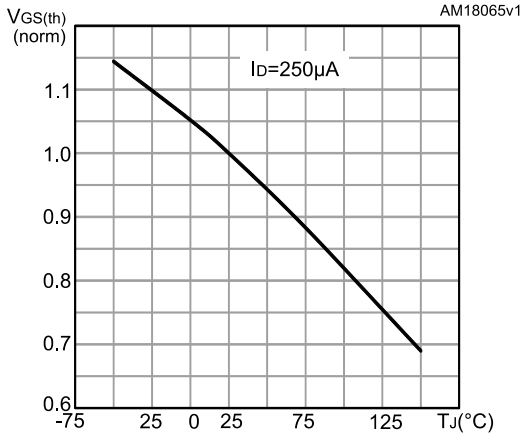


Figure 13: Normalized on-resistance vs temperature

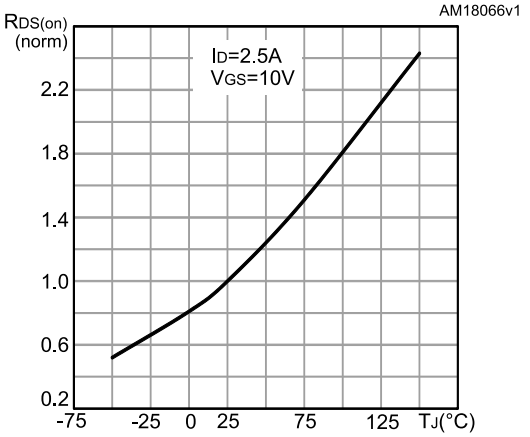


Figure 14: Source-drain diode forward characteristics

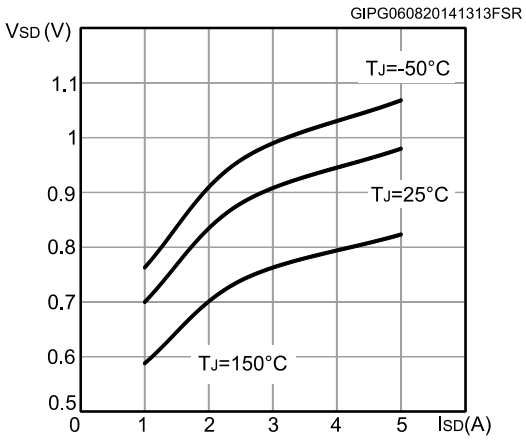
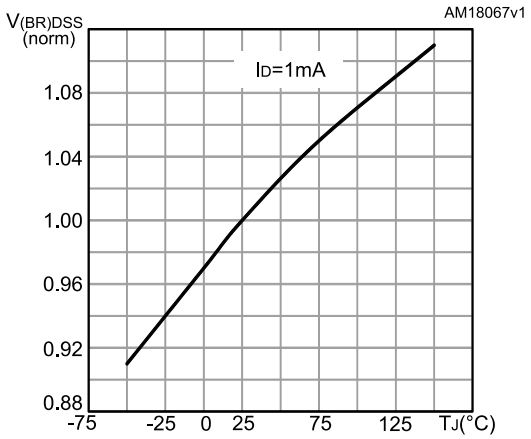


Figure 15: Normalized V(BR)DSS vs temperature



3 Test circuits

Figure 16: Switching times test circuit for resistive load

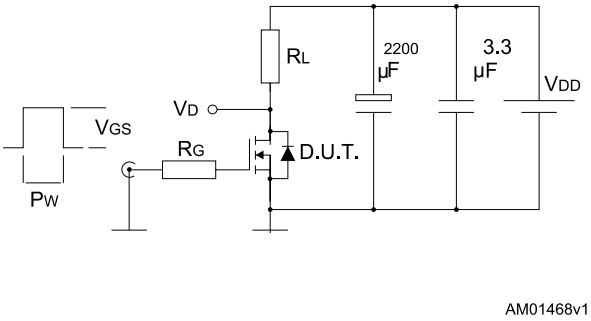


Figure 17: Gate charge test circuit

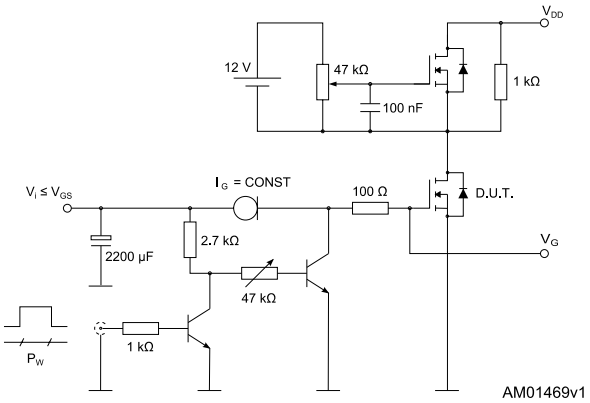


Figure 18: Test circuit for inductive load switching and diode recovery times

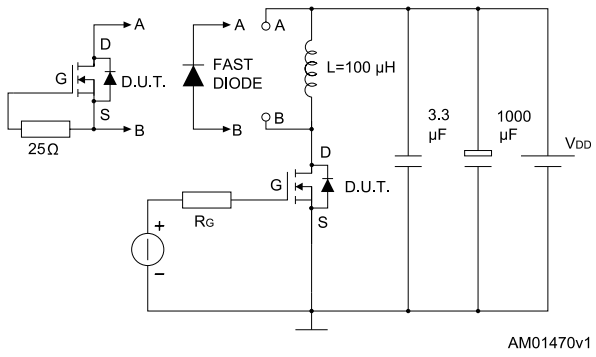


Figure 19: Unclamped inductive load test circuit

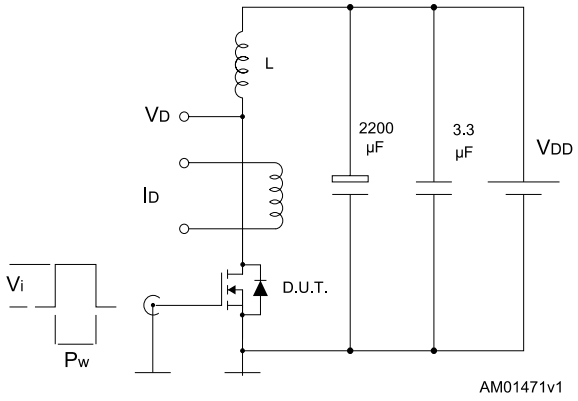


Figure 20: Unclamped inductive waveform

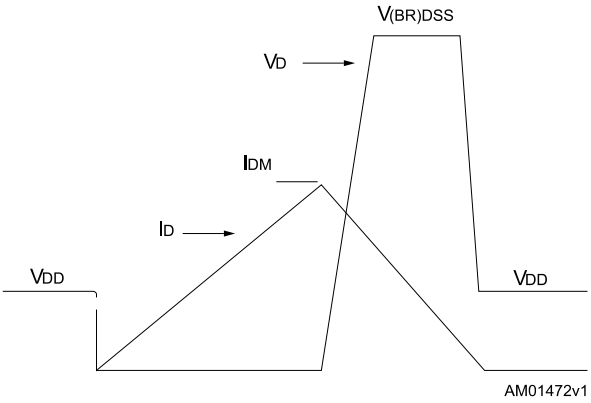
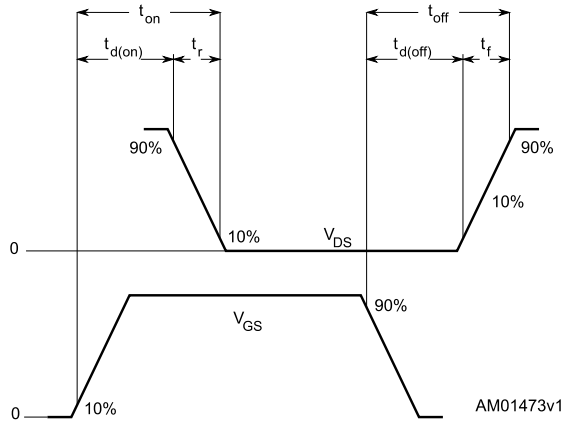


Figure 21: Switching time waveform



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: ***www.st.com***. ECOPACK® is an ST trademark.

4.1 TO-220 type A package information

Figure 22: TO-220 type A package outline

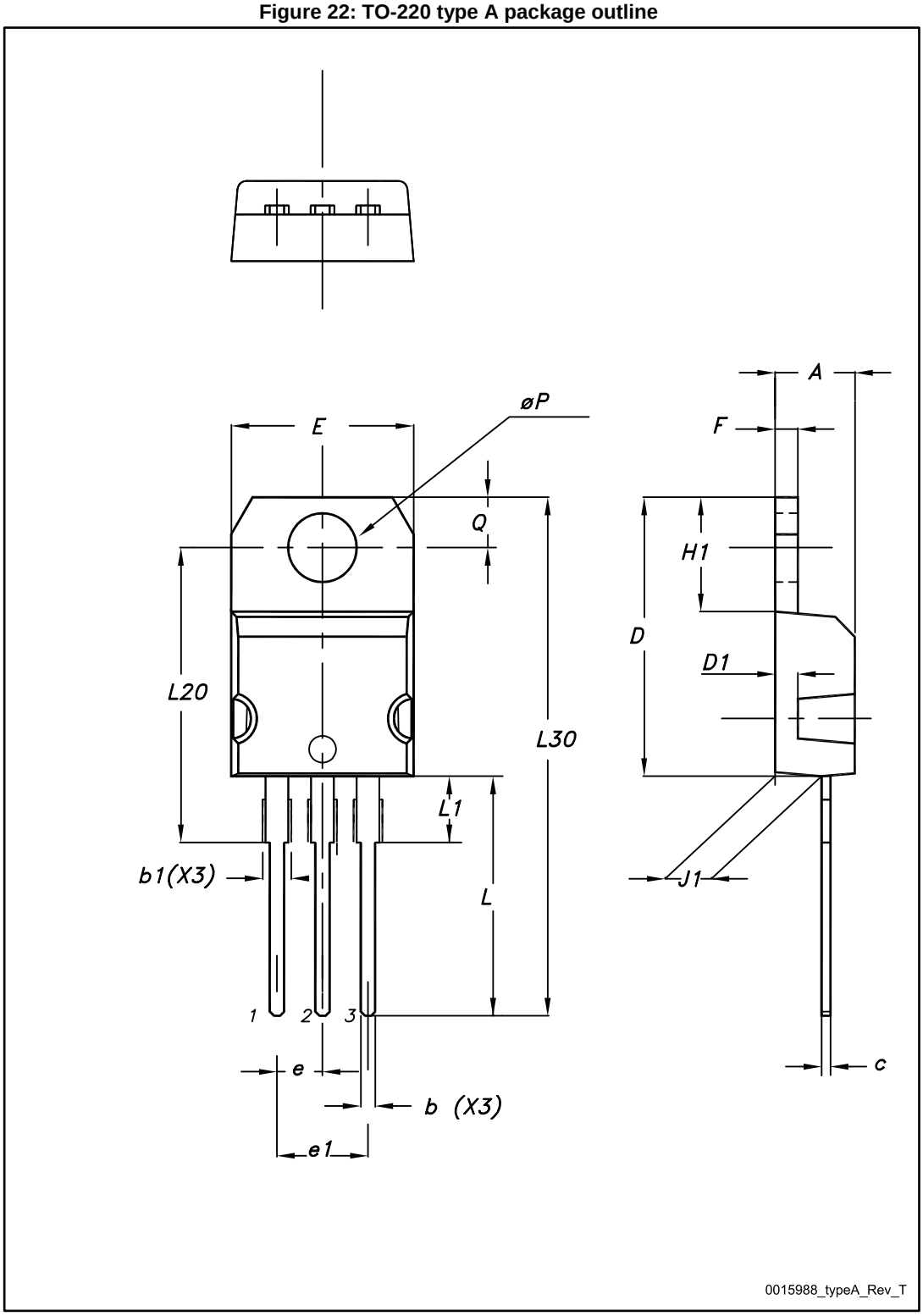


Table 9: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

4.2 IPAK(TO-251) type A package information

Figure 23: IPAK (TO-251) type A package outline

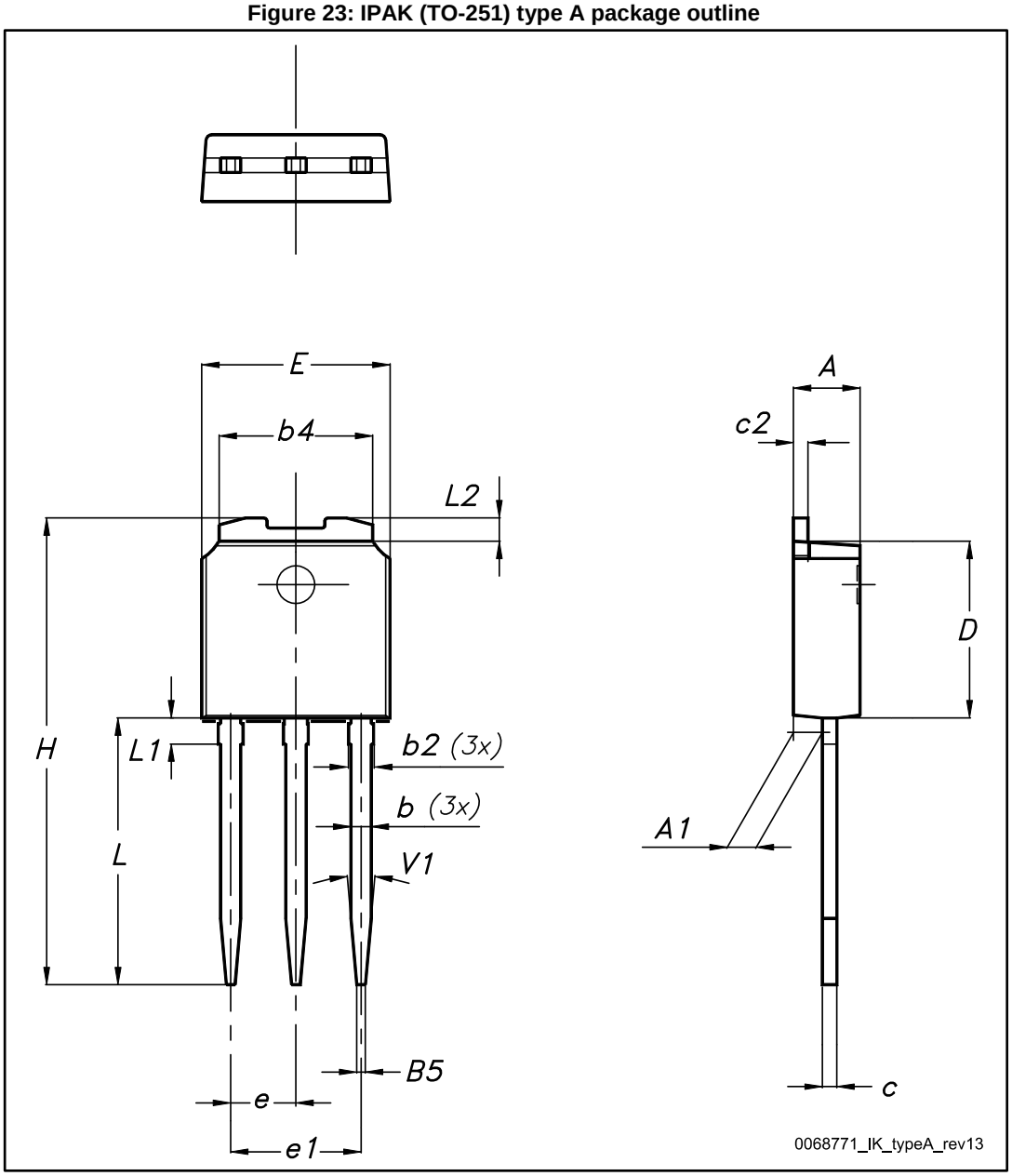


Table 10: IPAK (TO-251) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

4.3 IPAK (TO-251) type C package information

Figure 24: IPAK (TO-251) type C package outline

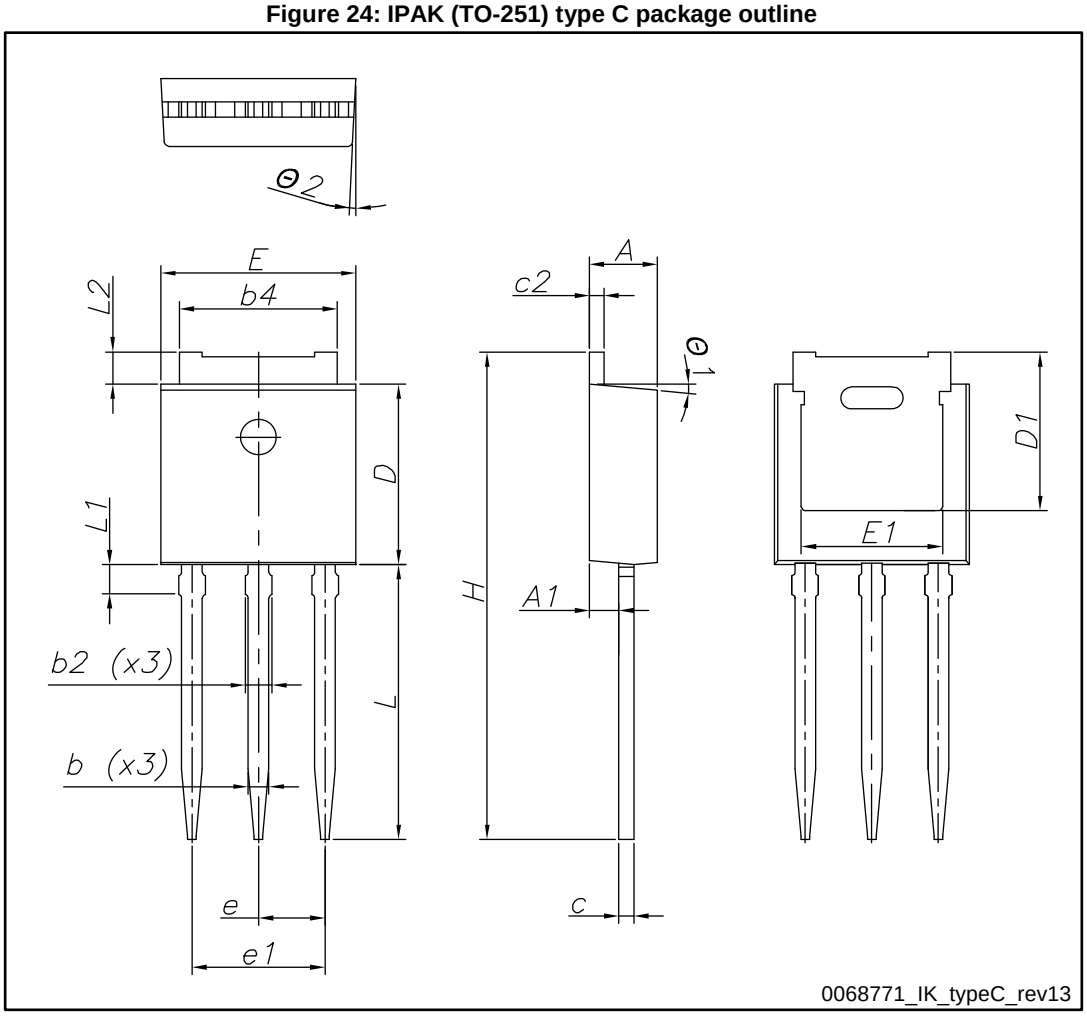


Table 11: IPAK (TO-251) type C package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.20	5.37	5.55
E	6.50	6.60	6.70
E1	4.60	4.78	4.95
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.90	1.00	1.20
L2	0.90	1.08	1.25
ϑ1	3°	5°	7°
ϑ2	1°	3°	5°

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
07-Aug-2014	1	First release.
09-Oct-2014	2	Added and . Updated not found. Minor text changes.
28-May-2015	3	Document status promoted form preliminary to production data. Updated package information.

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